

Discharge valve for CO₂ pressure cylinders

The present invention concerns a discharge valve for CO₂ pressure cylinders, comprising a flow passage for CO₂ gas, a valve element which is actuatable from the exterior and which can assume various positions and which in at least one of said positions closes the flow passage and in at least one other of said positions opens the flow passage, and connecting means for fixedly and sealingly connecting the discharge valve to a CO₂ pressure cylinder, wherein provided in the flow passage is a flow resistance which is independent of the valve opening which is openable by the valve element.

Corresponding discharge valves are known for example from US patents Nos 4 611 628 and 5 305 794. In US No 4 611 628 the additional flow resistance serves only as a switching aid for the valve, in which respect an intermediate pressure chamber which is disposed downstream of the flow resistance is initially emptied upon opening of the valve so that the valve body of which one end is in the intermediate pressure chamber is acted upon from its other end by the pressure of the pressure container and is thereby completely opened. In the case of US No 5 305 794, the arrangement has a valve connection which projects into a pressure container and which has two oppositely disposed bores which permanently provide a communication for an inner valve passage 70 to the interior of the pressure vessel. Those openings are of such dimensions that, even in the event of the outer valve portion breaking off, excessively large amounts of the gas contained in the container do not issue therefrom. At the same time, also provided on the valve connection which projects into the container is a check valve which opens a larger opening cross-section when the valve is acted upon from the outside by a pressure, in order for example to fill the container.

The above-indicated publications are however not concerned with the problem that the valve, instead of being acted upon by gas, could possibly also be acted upon by liquid, in which case the liquid which issues could

tend to involve very great expansion outside the cylinder or while still in the valve and could possibly also cause an explosion of external parts which are not as pressure-resistant as the pressure container.

Another known discharge valve is shown by way of example in Figure 5 1 of the accompanying drawings. In that case the discharge valve is a resiliently biased disk valve with an actuating nipple which projects at an end of the valve out of a recess. By pressing in the nipple, the valve disk is urged off its seat and thus opens a flow passage for CO₂ gas. In general terms the one end of such a discharge valve is fixedly screwed to a CO₂ 10 pressure cylinder, in which case, by way of the screwthread, a collar which projects in a flange-like configuration, is pressed with an O-ring against the flat edge extending around the screwthreaded opening of a CO₂ pressure cylinder and thus connects the valve fixedly and sealingly to the CO₂ pressure cylinder. The other end is generally also screwed to an actuating 15 device which also has a pressure-reducing device, in which respect parts on the pressure-reducing device are designed to actuate the actuating nipple of the discharge valve as soon as the pressure-reducing device is suitably set and CO₂ gas is to be taken from the pressure cylinder.

Furthermore, discharge valves of that kind generally also have an 20 over-pressure safety valve which, upstream of the valve element which is actuatable from the exterior, is connected to the flow passage of the discharge valve and which for example has a bursting disk which ruptures when a pressure limit value is attained in order to prevent the pressure gas bottle from exploding.

CO₂ 25 pressure cylinders with corresponding discharge valves are in the meantime used relatively frequently for the production of what is known as soda water, that is to say drinking water to which carbon dioxide or CO₂ has been added. Increasing numbers of households have gone over to themselves producing corresponding drinking water with CO₂ added 30 thereto, in colloquial speech also referred to as fizzy water or 'fizz', as that turns out to be considerably less expensive than buying bottled fizzy water as is generally commercially offered.

Special devices are provided for adding CO₂ to drinking water, for domestic use, in which devices on the one hand the CO₂ pressure cylinder is held and in which on the other hand a sufficiently pressure-resistant drinking water bottle can be accommodated, which can be connected in 5 sealed relationship to the CO₂ pressure gas cylinder by way of the pressure-reducing device already mentioned above and corresponding feed conduits. As soon as a corresponding drinking water bottle has been fitted into or clamped in the device, a valve is actuated which, by way of the pressure-reducing device and the valve element of the discharge valve, 10 provides the communication with the CO₂ pressure gas cylinder so that CO₂ gas flows into the bottle filled with drinking water, under a pressure which is typically in the range of between 2 and 10 bars, and in so doing is dissolved in the drinking water. After the drinking water has been subjected to the action of CO₂ gas under a suitable pressure for some seconds the 15 valve is closed again and the drinking water bottle can be removed and thus the CO₂ gasified drinking water is ready for consumption. In general the drinking water bottle also has a closure in order to prevent rapid and premature degassing of the water.

So-called 'soda devices' of that kind are already in use in their 20 millions and have proven their worth in principle. It has been found in practice however that the degree of gassing of the drinking water with CO₂ cannot always be kept at the same level, in spite of an identical period of actuation of the CO₂-gassing valve. In particular inclined positioning of a corresponding soda device or more or less inclined fitment to the wall can 25 also have the result that it is not always the same amount of CO₂ that is dissolved in the drinking water, as when a corresponding soda device is positioned upright.

Furthermore it would frequently be desirable to store or mount the soda device in an inclined or recumbent position, in which case only the 30 drinking water bottle would have to assume a substantially vertical position, upon being removed and fitted thereto. Pivotal connecting heads for corresponding drinking water bottles are already known. For reasons of space there would be a wish now and then in particular for the

CO₂ pressure gas cylinder to be also disposed in a fitment position other than the usual upright position, in or on the soda device. When a recumbent position is involved however, in the case of a filled CO₂ pressure gas cylinder, the CO₂ would firstly pass into the pressure-reducing device in 5 liquid form, in which case it admittedly evaporates and in so doing cools down but then in the general case more CO₂ is dissolved in the drinking water than when the CO₂ passes into the pressure-reducing device only in gas form so that that situation can entail a greater degree of gasification of the water than the user wishes. Admittedly the filling valves can generally 10 be so set that they possibly vent excess CO₂ to the exterior and the desired gasification pressure is generally also adjustable, but nonetheless letting out excess CO₂ is generally undesirable.

In addition, in the case of a recumbent CO₂ pressure gas cylinder, differing conditions would occur in the course of gradual emptying of the 15 pressure gas cylinder as initially only liquid CO₂ passes out of the bottle and into the pressure-reducing device, after a certain time a mixture of liquid and gaseous CO₂ would issue and finally only gaseous CO₂ could issue when the level of liquid has fallen sufficiently. With the varying conditions therefore the user would always have to re-set the valves in order to 20 maintain the respective gasification pressure and degree of gasification that he wanted and in that respect to allow as little excess CO₂ to escape as possible.

In comparison with that state of the art, the object of the present invention is to provide a discharge valve for CO₂ pressure gas cylinders, 25 which ensures always constant filling conditions if possible in any installation positions of a CO₂ pressure gas cylinder, so that there is no longer any need to change desired valve settings once made by the user.

That object is attained in that the flow resistance is such that at a temperature of 20°C and a CO₂ gas flow rate of 0.5 g/s it causes a pressure 30 drop of at least 1 bar, preferably of more than 3 bars.

It will be appreciated that the flow rate specified herein and the pressure drop relate to CO₂ in the gaseous condition.

It will also be appreciated that a valve with a more or less small or large valve passage opening affords a certain flow resistance, but in accordance with the invention there is to be provided an independent flow resistance which guarantees a greater pressure drop than is possible with 5 the usual valve element of a discharge valve and thereby prevents the passage therethrough of liquid CO₂, at any event in relatively large amounts. Otherwise the nature of the configuration of the flow resistance is not subject to any limitations. It may involve an additional valve or 10 pressure-reducing device, a plug with fine bores or other installation member, which only serves the purpose, by impeding a flow of liquid CO₂, of forcing it to convert into the gaseous condition before the CO₂ leaves the discharge valve.

A still more preferred embodiment is one in which such a flow resistance, under the specified conditions, causes a pressure drop of more 15 than 5 bars and preferably more than 10 bars. On the other hand however the flow resistance should also be such that, with a CO₂ flow rate of 0.5 g/s and at a temperature of 20°C, it does not produce a pressure drop which is greater than 50 bars, and it is better if the pressure drop is less than 40 bars and particularly preferably less than 30 bars. An excessively high 20 pressure drop at the specified flow rate would otherwise mean than normal filling of the drinking water bottle with CO₂ gas, to produce a suitable fizzy filling, would take a relatively long time.

A most preferred embodiment of the invention is one in which, under the specified conditions, the flow resistance produces a pressure drop of 25 between about 12 and 15 bars.

By virtue of the high flow resistance and due to the pressure drop which is related thereto at a corresponding flow rate, liquid CO₂ goes into the gaseous condition on flowing through the flow resistance so that it is practically impossible for the CO₂ to pass through the flow resistance in 30 liquid form.

In other words, even if the CO₂ pressure gas cylinder is turned upside down and in that situation the discharge valve is actuated, the flow resistance nonetheless provides that the CO₂ can pass through or issue

from the flow resistance only in gaseous form, thereby ensuring that CO₂ cannot pass into and through the pressure-reducing device in liquid form.

This ensures the desired constancy of the amount of CO₂ dissolved in the drinking water, under very different external operating conditions and 5 when the CO₂ pressure cylinder is in any installation position.

Desirably, in addition to the flow valve, there is a check valve which in the intake direction opens a by-pass which by-passes the flow resistance but closes it in the discharge direction. As the corresponding pressure gas cylinders are generally also filled by way of the discharge valve, more 10 specifically under a relatively high pressure of about 90 bars, using CO₂ in liquid form, the above-mentioned flow resistance in the discharge valve would be a severe impediment and would prolong the filling times of the CO₂ pressure gas cylinders by a multiple. By virtue of the fact that the arrangement has a check valve which opens in that filling direction and 15 which permits the flow resistance to be by-passed, the filling operation is not impeded.

Desirably the check valve in question is resiliently biased in the closing direction.

The flow body can be for example a sintered body, but it is equally 20 possible also to use a pressure-resistant diaphragm.

In the preferred embodiment the flow resistance is made from plastic material or ceramic material, for example in the form of a porous sintered body. Equally however the flow resistance could also be made from a metallic sintered body.

25 The preferred average pore size of such a sintered body or other porous material should preferably be of the order of magnitude of between 1 and 10 µm, in which respect the porosity can be between 10% and 80%.

In an embodiment of the discharge valve according to the invention the flow resistance in the form of a porous sintered body can be a valve 30 body which is accommodated movably in a valve seat. This 'valve' formed by a sintered body or other porous or partially permeable element would admittedly not be sealed in the closed condition but in the closed condition would still allow the passage therethrough of the quantities which can pass

through the flow body which here is in the form of a valve body, but at the same time that valve body can be moved out of its seat and thus (in the intake direction) would open a considerably larger flow cross-section whose flow resistance would be negligible. In that case therefore the flow 5 resistance itself would form a part of a check valve. It will be appreciated that, in this case, the flow resistance which is in the form of a valve body should be biased resiliently against a valve seat in the discharge direction so that, when the valve body is acted upon from the outside, more 10 specifically upon filling the CO₂ pressure cylinder, the flow resistance is urged out of its valve seat and thereby opens the by-pass for by-passing the flow resistance. Desirably, the valve body is in the form of a flow resistance with a tapered end which comes into engagement with the valve seat.

A particularly preferred embodiment of the invention is one in which 15 the flow resistance is provided in an attachment portion which can be connected to the actual discharge valve. For example that attachment portion can be provided at one end with a male screwthread in the manner of a screw and is then screwed, in place of a closure screw, into the lower end of such a discharge valve, in which case such a conventional closure 20 screw is generally screwed into the lower end of a through opening in the discharge valve and serves as a support for a valve spring which is arranged in that passage or flow duct and which biases the actuating valve of the discharge valve in the discharge flow direction. It will be appreciated that such a closure or support screw has a bore therethrough for CO₂ to 25 pass substantially unimpededly therethrough and the attachment portion can equally also be bored therethrough and can have the above-mentioned flow resistance in that through bore.

In that respect however it may be necessary, possibly from the interior of the pressure cylinder, to make a separate communication with a 30 bursting disk, or to provide the flow resistance only beyond a branch duct to the bursting disk in the discharge valve. It will be appreciated in that respect that it is desirable if the overall diameter of the attachment portion is smaller than the inside diameter of the screwthread of the opening in the

pressure cylinder, into which the discharge valve is screwed. In that way it is very easily possible for conventional discharge valves to be equipped with the additional component according to the invention, insofar as the bored closure screw is simply replaced by the attachment portion according 5 to the invention, which on the one hand functions as a closure screw and forms a support for the valve spring which is provided in any case in the discharge valve, but at the same time it also includes the flow resistance which substantially prevents CO₂ from passing through in liquid form or so severely limits it in terms of quantity that on the side of the pressure-10 reducing device, there are practically always equivalent operating conditions prevailing, which without avoidable CO₂ losses result in a uniform degree of gasification of the fizzy water.

The present invention is directed in that respect also to the attachment portion which is to be sold separately from the discharge valve 15 and which can be connected to a discharge valve and which includes a corresponding flow resistance.

Further advantages, features and possible uses of the present invention will be clearly apparent from the description hereinafter of a preferred embodiment and the accompanying Figures in which:

20 Figure 1 shows a discharge valve in accordance with the state of the art,

Figure 2 shows a first embodiment of a supplemented flow valve according to the invention with a flow resistance and a check valve additionally provided therein,

25 Figure 3 shows a further embodiment with a flow resistance in the form of a valve body,

Figure 4 shows an embodiment similar to Figure 3, but in which the valve body additionally has better guide means, and

Figure 5 shows a view in section taken along line V-V in Figure 4, in 30 which it is possible to see the cross-section of the guide portion of the valve body.

Referring to Figure 1, the discharge valve 100 which is known from the state of the art comprises a valve body 1 with a flow passage 8 and an

actuating valve 10. The actuating valve 10 in turn comprises the valve disk 2, the actuating nipple 3 connected thereto, the guide portion 4 of the valve element, a valve spring 9 and a support screw 7. The support screw 7 has a bore therethrough and provides a flow passage 11 which 5 communicates with the main flow passage 8. The guide portion 4 has either clearance, longitudinal grooves or bores, which ensure that the flow passage 8 opens a corresponding discharge cross-section for the CO₂ gas when the actuating nipple 3 is pressed in and the valve disk 2 is disengaged from its seat. The lower portion of the valve body 1 has a male screwthread 6 which is screwed into a corresponding female screwthread in the opening of a pressure gas bottle or cylinder. In that situation an O-ring 5 comes into engagement with a flat edge which extends around the opening of the pressure gas cylinder and is pressed firmly and sealingly on to that edge by a collar 12 provided on the valve body 1 above the O-ring 10 5. An over-pressure valve 20 is additionally in communication with the flow passage 8 and, when a corresponding over-pressure occurs, opens a vent opening in order to prevent the pressure gas cylinder from exploding.

Figure 2 shows a first embodiment of a discharge valve 200 modified in accordance with the invention, in which respect the modification is essentially that the support or closure screw 7 has been replaced at the lower end of the valve by an attachment portion 30 which has an attachment body 34 in which there is accommodated a porous sintered body 31 having a central bore with a check valve provided therein. The check valve 15, 16, 17 is biased in the discharge flow direction by means of a spring 17 and communicates with a corresponding valve seat within the sintered body 31. When pressure is applied from the side of the pressure gas cylinder that check valve 15, 16, 17 is closed so that CO₂ can only pass through the porous sintered body 31 in the flow passage 8 when the valve element 10 is actuated.

30 In the embodiment shown in Figure 3, the closure screw 7 of the valve 100 is also replaced by an attachment portion 30'. In this case a partially permeable check valve is formed by the body 34' of the attachment portion 30' and a sintered body 32 which is accommodated

therein and which is of a tapered configuration in the upper part. The sintered body 32 is biased by a spring in the discharge flow direction against a tapered valve seat provided in the attachment body 34', with the spring being supported against a support screw 7' having a through bore 5 11', similarly to the support screw 7 of the valve in the state of the art. In the discharge flow direction, the CO₂ has to pass through the sintered body 32 and can pass into a pressure-reducing device by way of the passage 11', 8 and the valve element 10.

In contrast, in the intake direction, the pressure of the inflowing CO₂ 10 gas or the CO₂ in liquid form provides that the porous sintered body 32 is urged away from its valve seat so that the CO₂ can flow into the pressure gas cylinder past the sintered body 32.

The embodiment shown in Figure 4 is very similar to that shown in Figure 3, except that in this case the lower portion of the porous sintered 15 body 33 is of a substantially cylindrical configuration, of an outside diameter which substantially corresponds to the inside diameter of the body 34" in its lower part, so that as a result the porous sintered body 33 has good guidance and cannot tilt. For the purposes of allowing the CO₂ gas or the CO₂ in liquid form to pass therethrough in the operation of filling a 20 pressure gas cylinder, provided in the cylindrical guide portion of the sintered body 33 are grooves 35 extending in the longitudinal direction so that, when the sintered body 33 is pushed back against the spring 9' in the operation of filling the pressure cylinder and as a result a passage is opened between the tapered valve seat and the tapered portion of the 25 sintered body, the CO₂ can also flow into the pressure gas cylinder, past the cylindrical portion, through the longitudinally extending grooves 35.

The cross-section of that cylindrical portion with the two grooves 35 can be clearly seen in Figure 5.